THE EFFECTIVENESS OF HAND-ARM BIMANUAL INTENSIVE THERAPY (HABIT) ON UPPER EXTREMITY FUNCTIONAL RECOVERY IN HEMIPLEGIC PATIENTS

A PROJECT WORK SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF OCCUPATIONAL THERAPY

(ADVANCED O.T. IN NEUROLOGY)

Submitted By

Reg No. 41091209

JKK MUNIRAJA MEDICAL RESEARCH FOUNDATION

COLLEGE OF OCCUPATIONAL THERAPY

KOMARAPALAYAM – 638 183

Affiliated by

THE TAMILNADU DR.M.G.R.MEDICAL UNIVERSITY

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PRINCIPLE EXTERNAL EXAMINER

GUIDE INTERNAL EXAMINER

<u>CERTIFICATE</u>

This is to certify that the Project work entitled, "**THE EFFECTIVENESS OF HAND-ARM BIMANUAL INTENSIVE THERAPY (HABIT) ON UPPER EXTREMITY FUNCTIONAL RECOVERY IN HEMIPLEGIC PATIENTS"** is a bonafide compiled work carried out carried out by **Reg. No. 41091209,** Final year student, College of Occupational Therapy under J.K.K. Munirajah Medical Research Foundation, Komarapalaym - 638 183, in partial fulfillment for the award of Degree of **"Master of Occupational Therapy" (Advanced O.T. in Neurology)** of **The Tamilnadu Dr. M.G.R. Medical University, Chennai-32.** This work was guided and supervised by **Dr. A.P.GANESAN, M.B.B.S., DPMR., MD (PMR).,** at the Department of Occupational Therapy, JKKMMRF, Komarapalayam

Mr.M.SARAVANA ROENTGEN MANI, M.I.Th.,
PRINCIPAL
M.Sc. (OT), PGDR. (OT)
J.K.K. Munirajah Medical Research Foundation,
Komarapalaym

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Dr. A.P.GANESAN,
M.B.B.S., DPMR., MD (PMR).,
Chief Medical Officer,
Annai J.K.K. Sampoorani Ammal Trust Hospital,
Komarapalaym.

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Reg.No:41091209

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ABSTRACT

BACKGROUND OF THE STUDY:

Patient with hemiplegia in general one side of the body will be affected. which will interfere Activities of Daily living and day to day activitie. This study is to determine whether occupational therapy intervention of HABIT (HAND-ARM BIMANUAL INTENSIVE THERAPY) - Training would effectively improve activities of daily living and day to day activities.

AIM:

The Aim of the stduy was to determine the effectiveness by HAND-ARM BIMANUAL INTENSIVE THERAPY on upper extermity functional recovery in hemiplegic patients.

METHODOLOGY:

STUDY DESIGN:

1. Randomized control study design
2. Experimental pre and post test design

SUBJECT:

1. Both male and female patients were taken
2. Both right and left hemiplegics were taken
3. Total number of subjects 30
4. The study was conducted at the Occupational Therapy Department in URC Hospitals.

INDEPENDENT VARIABLE:

Duration and frequency of Bimanual activity

DEPENDENT VARIABLE:

Involved upper extremity function

DISCUSSION:

HABIT (HAND-ARM BIMANUAL INTENSIVE THERAPY) was used initially for the Cerebral Palsy children's and it proved to be useful. Findings of this study are consistent with other studies providing intensive practice, although the duration of HABIT given to the patients in the study.

CONCLUSION:

There is a significant improvement in upper extremity function of hemiplegic patient who received HABIT-Training in occupational therapy intervention.

INTRODUCTION

Stroke is defined as rapidly developed clinical signs of focal (or global) disturbance of cerebral functions lasting >24 hours. It includes the patients presenting clinical signs and symptoms suggestive of subarachnoid hemorrhage, intracerebral hemorrhage or cerebral ischemic necrosis. It does not include transient cerebral ischemia or stroke events in cases of blood disease (e.g. leukemia, polycythemia vera), brain tumor or brain metastases. The focal signs are unilateral or bilateral motor impairment (including disco-ordination), unilateral or bilateral sensory impairment, aphasia, dysphasia (non fluent speech), hemianopsia (half sided impairment of visual field), diplopia, forced gaze, conjugate deviation of acute onset, apraxia of acute onset, ataxia of acute onset, perception deficits of acute onset (Who Monica Project 2007).

The disturbance of cerebral function is caused by 3 morphological abnormalities, i.e, stenosis, occlusion or rupture of the arteries. Hemiplegia constitutes the main somatoneurological disorder in about 90% of the patients. Stroke is a worldwide health problem. It makes an important contribution to morbidity, mortality and disability in developed as well as developing countries.

After CVA, upper motor neuron paralysis follows a one-sided distribution and includes musculature of the trunk and limbs on the affected side. The paralysis is usually characterized by increase muscle tone, called hyper tonicity or spasticity, co-ordination or control of smooth, rhythmic movement is lost, normal postural mechanisms are disturbed, adaptive changes of muscles tone as a protection against the force of gravity, referring to the ability to control slow, unresisted movements in the direction of gravity is also lost (Pedretti LW, 1996).

Initial upper extremity paralysis is found in one third of all patients. Moderate or mild paresis in the upper extremity is seen in a further one third of group. However, these deficits translate into different impairments of motor function in sub acute phase. The upper extremity is found to be completely dysfunctional in only 20% (one quarter with partial function) (Kreisel SH, Hennerici MG, Bazner H, 2007).

So, for the hemiplegics is very difficult to do the normal activities efficiently as our limbs are the tools that enable us to make gestures, and engage in age specific purposeful activities. Manipulating small objects, and exploring their shape and texture, require highly skilled hand and finger movements. The neural circuitry necessary for controlling these movements is most developed in higher primates, especially in man (Nakajima K et al, 2002). Prehension or the use of hands and arms effectively, includes the components of visual regard, reach, grasp, manipulation and release. All function of upper extremity seem to reach grasp, manipulation and release. All functions of upper extremity seem to be very easy, but in the central nervous system, something very complex happens in an automatics way which makes this process look easy.

A substantial amount of anatomical, electrophysiological and clinical evidence suggests that the principal constituent of the motor system underlying the performance of highly skilled finger movements is the corticospinal pathways, more specifically, its corticomotoneuronal component. The portion of the corticospinal tract originating from the primary motor cortex is necessary, and largely sufficient, to control skilled hand movements. However, functional imaging studies have shown that large network including several other contralateral and ipsilateral cortical areas is also involved in the control of fine finger movements (Frossberg H. et al, 1999).

According to the principles of neuroplasticity parts and processes of central nervous system are not very rigid, it means if one part is damaged then the other part takes over the function. In patients with chronic stroke, the primary motor cortex of the intact hemisphere may influence functional recovery, possibly through transcallosal effects exerted over M1 in the lesioned hemisphere. (Mursae N, Duque J, Mazzochhio R, Cohen LG, 2004).

Supplementary motor regions in the ipsilesional and contralesional hemisphere play a role in recovery, little is known about the tine course of cortical activation in these regions as recovery proceeds (Marshall RS et al, 2000). These observations suggests that, although the primary motor cortex is a prerequisite for the execution of skilled finger movements, their precise programming and control involve highly specialized brain structures.

The neuromotor control perspective considers the biomechanical, neurological and environmental constraints which impact motor skills. Neuromotor factors that influence prehension development include: adaptability, anticipatory control, unimanual / bimanual coordination and object manipulation. Internal representation of object properties is formed from past experiences, and retrived from memory to grade finger tip forces in advance of contact. Internal representations are used to plan grip and load forces in advance of contact to prevent damage from gripping too tightly or lifting too quickly.

A range of management approaches based on different ideas about motor recovery following stroke have been implemented. In the 1950s and 1960s neurofacilitation approaches based on available neurophysiological knowledge were developed, including the Bobath approach (Davies P, 1999), which became the most commonly used method. In the 1980s the potential importance of neurophysiology and motor learning was highlighted (Schmidt RA, 1991) and the motor learning, or relearning, approach (Carr JH & Shepherd RB, 1987) was proposed. The Bobath approach has emphasisid the importance of facilitating movement and 21 of tactile stimulation (hands on) (Davies P, 1999), while the Motor Relearning Programme emphasizes active patient involvement with focus on goal setting, and task-specific practice to improve function after stroke (Carr JH & Shepherd RB, 1987). Within the Motor Relearning Programme approach, the actions to be learned are practiced in an appropriate context, with exercises directed specifically at the muscles required for the performance of the action, working through the range at which they must generate force. Furthermore, the patients practice movement tasks with the therapist as a coach who encourages the performance by instruction, manual guidance, demonstration or verbal feedback. Instructions are given in such a way as to present a clear goal and to reduce uncertainty. Manual guidance may be used in the early phase to give the patient an idea about what to do. The action to be executed can be demonstrated either alive or on videotape, a verbal feedback is given to provide information about achievement of the goal and how the movement was performed (Carr JH & Shepherd RB, 1998). Shumway-Coock A & Woollacott MH (2001) describe the Motor Relearning Programme as a task-oriented approach based on newer theories of motor control, also referred to as a system approach (Shumway-Coock A & Woollacott MH, 1991).

However, evidence and the results of questionnaire-based studies suggest that it is difficult to distinguish between the practical implementation of the two approaches (Vliet V et al, 2001). This is confirmed in the recent review by Pollock et al (2007), who recommends that further research should focus on investigating clearly defined and described techniques and task-specific interventions regardless of their historical or philosophical origin, in order to develop an evidence-based practices (Pollock et al, 2007). Besides all these approaches there are some other approaches also which are now in use very frequently and have proved to be useful. These are CIMT, task-oriented approach, mirror imaging, and the most recent one is HABIT (hand arm bimanual intensive therapy).

HABIT: HAND ARM BIMANUAL INTENSIVE THERAPY

HABIT (Gordon AM, Schneider JA, Chinnan A, Charles JR, 2007) Hand arm bimanual intensive therapy (HABIT) in cerebral palsy hemiplegics is a new intervention developed at Columbia university.

HABIT aims to improve the use and co-ordination of both arms in daily function. It involves intensive bimanual training. Like CIMT,(constrain induced movement therapy) it requires 90 hours of intensive therapy and it is performed in group settings. But unlike CIMT, HABIT focuses on improving the ability to perform bimanual activities.

The efficiency of this new bimanual treatment for improving co-ordination with two hands is being tested. To date, results indicate good efficacy and reinforce belief that efficacy of hand function is not dependent on the use of restrictive devices on the unaffected hand.

HABIT is a form of functional training that takes advantage of the key ingredient of CIMT (intensive practice), but focuses on improving co-ordination of two hands using structured task practice embedded in bimanual play and functional activities.

The activities which are given to the patients can be manipulative games and tasks, card games, video games, functional tasks, gross motor activities, arts and crafts.

Types of practice which can be incorporated are repetitive task practice and whole task practice. Repetitive task practice means patient will do part of activity repetitively till he masters those component and then progresses to another component, progression can be in forward direction or backward direction and for this first the given activity is analysed and is broken into parts and those parts are given to the patients to accomplish. On the other hand whole task practice means patients will practice whole task repetitively.

Type of involved hand use is also the factor which plays of role, means involved hand can be used as stabilizer, manipulator, active or passive assistance con be given by the involved hand, symmetrical and asymmetrical movements.
Constraints can be graded as changing the spatial and temporal constraints of task, for symmetrical task can be increased or decreased.

In bilateral upper extremity tasks, the CNS must control a greater number of degree of freedom than in unimanual tasks, resulting in greater cortical activation. There is both neuro-physiological and clinical evidence to suggest that bilateral movement may increase cortical excitability and therapy facilitate movement both in individual who are not disabled and in individual with impaired movement. The response of a muscle is greater when the contra-lateral homozygous muscle is contracted. In addition, there are more cortical motor areas active during bimanual motor, tasks, than during unimanual tasks, even when tasks are similar (Hoffman LR and Field-Fote EC, 2007).

Bimanual (or bilateral-training is a new class of interventions aimed at increasing the efficiency of movement in the context of using both hands together. The brain and spinal cord underlying human dexterity are capable of considerable re-organization after damage, likely responsible for recovery of function. Pathways on the same side (ipsilateral) of the impaired upper extremity have been implicated in the control of the affected hand in cerebral palsy as well as recovery of function after stroke in adults. Thus task recruitment of these ipsilateral pathways, such symmetrical bilateral movements may be beneficial. Bilateral practice may result in changes in cortical representations and excitability in the undamaged hemisphere. This reasoning has provided the basis for bilateral training protocols in adults with stroke (Bilateral training to increase functional independence in hemiplegic CP children-May 2007 Fact Sheet, UCPREF, 2007, www.ucpresearch.org).

Bimanual movement is a different entity from unimanual movement. The notion that bimanual movement is planned as a whole may explain the “bimanual coupling” paradigm and “bimanual specific activity”. In addition, it leads to a more holistic view of motor planning problem, its preferences and restrictions. Using the non-structured scribbling task in humans, it has been demonstrated that both hands are naturally coupled when special restrictions are not imposed (Gribova A, 2001).

The interlimb coordination that emerged for the stroke group revealed a complex and asymmetric contribution from each limb mediated through anticipatory and motor control processes. It was suggested that his coordination may be hamessed for future bimnanual intervention approaches to rehabilitation of upper limb functions after stroke (Rose DK and Winstein CJ, 2005).

Bilateral upper limb training with FES could be an effective method for upper limb rehabilitation of stroke patients after 15 training sessions (Chan MKL, Tong RKY and Chung KYK, 2009). Upper extremity rehabilitation protocol, for stroke hemi paresis has focused on the paretic limb with unilateral strengthening exercise, neuro-muscular re-education and/or functional training.

One recent approach, CIMT exploits this focus by physically constraining the non-paretic limb with a sling or safety mitt. However, many daily tasks naturally require the co-ordinate participation of both hands, providing a rationale for a bimanual approach to upper limb rehabilitation. A small but growing number of investigation, have provide evidence for the potential of bilateral training on the recovery of paretic limb after stroke.

In a study disruption of non paretic control of tapping was studied, particularly consistency of tapping, it was found that disruption occurred during bilateral tapping tasks but was responsive to 6 weeks of bilateral arm-based training. Despite the apparent lack of training specificity, the generalizable effects of bilateral arm training to fine motor inter-limb coordination may reflect central motor control mechanism for upper-extremity coordination, which may be accessed and may influence the recovery of arm function after stroke. The results of the magnetic stimulation experiments suggest that there is no common drive to left and right homologous muscle pairs that may be voluntarily co-activated but often act independently (Carr LJ, Harrison LM, Stephens JA, 1994). This is against the studies which are in favor of bimanual activities.

This finding implies that the improvement occurring during the first 5 weeks post stroke in the affected arm is clinically meaningful and may actually translate into greater use of the affected limb in “real-world situations”. This significance also indicates that having voluntary movement initially contributes to functional recovery (Higgins Jet al, 2005).

Although these studies reported paretic limb changes with a bimanual intervention approach, the focus was primarily on global measures of movement without any kinematics analyses of trajectory information. Although there are so many approaches and techniques developed to treat the stroke patients, a lot of work already has been done and a lot have to do. The aim of this study is to find out whether this HABIT is beneficial in improving the hand function in adult stroke patients.

RATIONALE

HABIT (Hand-Arm Bimanual Intensive Therapy was originally used for hemiplegic cerebral palsy children. There is no evidence that HABIT is used in adult stroke patients. Literature has been searched and no evidence has been found in CINHAL, PUBMED. There is evidence that bimanual practice is always much better than unimanual practice and also while doing our ADL routines we need bimanual functioning. However there is some suggestion that initial unimanual practice can transfer to improvements in bimanual co-ordination, suggesting that treatment can ameliorate poor bimanual co-ordination, Rather than defining increased unimanual use of the involved extremity as the therapeutic goal, the goal should be to increase functional independence by improving use of both hands in cooperation. However this might be best accomplished by practicing bimanual skills directly. So, aim of this study is to find out whether HABIT is efficacious or not in adult stroke patients.

AIM

To find out the effectiveness of hand arm bimanual intensive therapy (HABIT) on upper extremity functional recovery in hemiplegic patients.

HYPOTHESIS

NULL HYPOTHESIS

There is no effect of Hand Arm Bimanual Intensive therapy(HABIT) on upper extremity functional recovery in hemiplegic patients.

EXPERIMENTAL HYPOTHESIS

Hand Arm Bimanual Intensive Therapy can improve the upper extremity functional recovery in hemiplegic patients.

CORTICAL AND BRAIN STEM CONTROL ON MOTOR FUNCTION

The motor cortex and the corticospinal tract-the motor cortex in itself are divided into three sub areas.

The Primary Motor Cortex

The primary motor cortex lies in the first convolution of the frontal lobes anterior to the central sulcus. It begins laterally in the sylvian fissure, spreads superiorly to the uppermost portion of the brain and then dips into the longitudinal fissure. The primary motor neurons are involved in control of many aspects of voluntary motor control. The primary motor cortex has the densest population of corticospinal tract neurons. The high density of corticospinal tract cells accounts for the fact that very small amounts of electrical current applied to this area are capable of producing movements.

The presentation of the different muscle areas of the body in the primary motor cortex, beginning with the face and mouth region near the sylivian fissure, the arm and hand area in the mid portion; the trunk, near the apex of the brain, and the leg and foot areas in the part of the primary motor cortex that dips into the longitudinal fissure.

The Premotor Area

The premotor area lies immediately anterior to the primary motor cortex projecting one to three CNS anterior and extending inferiorly into the sylvian fissure and superiorly into the longitudinal fissure. Premotor neurons are variably active during. The presentation of the premotor area has mouth and face areas located must laterally and then moving upward and hand, arm, trunk and leg areas.

The Supplementary Area

The supplementary area lies mainly in the longitudinal fissure but extends a few cms onto the superior frontal cortex. This area functions in consent with the premotor area to provide attitudinal movements of the head and eyes.

TRANMISSION OF SIGNALS FROM THE MOTOR CORTEX TO THE MUSCLES

Motor signals are transmitted directly from the cortex to the spinal cord through multiple accessory pathways that involve the basal ganglia, cerebellum of the brain stem.

The Corticospinal Tract

Information received and processed by the motor cortex must reach the muscles to produce movement; the most direct route is the corticospinal tract.

The corticospinal tract originates about 30% from the primary motor cortex, 30% from the premotor and the supplementary motor areas and 40% from the somatosensory areas. The tract when leaves the cortex, passes through the posterior limb of the internal capsule and then downward through the brain stem forming the pyramids of medulla. The majority of the pyramidal fibres crosses in lower medulla to the opposite side and descend into the lateral corticospinal tract of the cord, termination on the intermeurons in the intermediate regions of the cord.

A few of the fibers do not cross to the opposite side in the medulla but pass ipsilaterally down the cord in the anterior corticospinal tract. Most fibers in the pyramidal tract are population of large myelinated fibers with a diameter of 16 micrometers. These fibers originate from the giant pyramidal cells called the Betz cells found only in the primary motor cortex. Most corticospinal tract axons end by contacting intemeurons in the spinal cord. Some however end directly on the motor neurons, forming a tight link between the cortex and the muscles. Such corticospinal tract cells are given special name, corticomotoneurons. These cells project only to muscles that innervate the distal upper extremities. Gradual myelination of these fibers after birth corresponds to the development of skilled hand functions. (Cohen H 1999).

INCOMING FIBRE PATHWAYS TO THE MOTOR CORTEX

The functions of motor cortex are controlled mainly by the nerve signals from the somatosensory system but also, to a lesser degree from other sensory system. Once sensory information is received from the sources, the motor cortex operates in association with basal ganglia and the cerebellum to excite the appropriate course of motor action. Sub cortical fiber from adjacent regions of the cerebral cortex.

Somatosensory fibers that arrive directly from the ventro basal complex of the thalamus.

Tracts from the ventrolateral and ventroanterior nuclei of the thalamus, which in turn receives signal from the cerebellum and basal ganglia. These tracts provide signals that are necessary for the coordination between the motor control function of motor cortex, basal ganglia and cerebellum.

Fibres from the intralaminar nuclei of the thalamus. Sub cortical fibres that arrive through the cerebral cortex from the opposite cerebral hemisphere. These fibres connect corresponding areas of the cortices in the two sides of the brain.

FUNCTION OF THE CORPUS CALLOSUM AND THE ANTERIOR COMMISURE

Fibers in the corpus callosum provide abundant bidirectional neural connections between most of the receptive cortical areas of the two hemispheres. One of the function of the corpus callosum and the anterior commisure is to make information stored in the cortex of one hemisphere available to corresponding cortical areas of the opposite hemisphere.

Serrien DJ, Nirkko AC, Wiesendanger M, 2001. A study to investigate the temporal control in patients with congenital as compared to acquired pathology of the corpus callous during two different bimanual paradigms. Observations in their study indicated that patients with congenital absence of the corpus callosum can make use of compensatory mechanisms for allowing temporal synchronization during bimanual movements whereas patients with acquired callosal dysfunction are severely hampered when the task places significant demands on the control processes. The data also underlined that the ability of callosal patients to precise time events in coordinated actions depends on the task constraints.

Gerloff C, Andres FG, 2002 studied that bimanual coordination of skilled finger movements requires intense functional coupling of the motor areas of both cerebral hemispheres. Since bimanual coordination is a high-level capability that virtually always requires training, this review focused on changes of interhemispheric coupling associated with different stages of bimanual learning. Evidence was provided that the interaction between hemispheres is a particular importance in the early phase of command integration during acquisition of a novel bimanual task. It was proposed that the dynamic change in interhemispheric interaction reflects the establishment of efficient bimanual 'motor routine'. The effects of callosal damage on bimanual coordination and learning were reviewed as well as functional imaging studies related to bimanual movements. Evidence for an extended cortical network involved in bimanual motor activities which comprises the bilateral primary sensorimotor cortex (SMI), supplementary motor area, cingulated motor area, dorsal premotor cortex and posterior parietal cortex was also presented.

CAUSES OF STROKE

OCCLUSION (50%)

A: Atheromatous/thrombotic

Vessel occlusion

- Large : carotid artery
- Branches: middle cerebral artery
- Perforatorrs : lacunar infarction

Non-atheromatous diseases of the vessel wall

- Collagen diseases (rheumatoid arthritis, systemic lupus erythematosis).
- Vasculitis (polyarteritis nodosa, temporal arteritis).
- Granulomatous vasculitis (wegener's granulomatosis)
- Misscellaneous(syphilitic vasculitis, fibromucular dysplasia, sarcoidosis, trauma).

B: Embolisation (25%)

- Atheromatous plaque in the intracranial or extracranial arteries or from aortic arch.

2. From the heart.

- Valvular heart diseases.
- Arrhythmias
- Ischaemic heart diseases
- Bacterial and non bacterial endocarditis
- Atrial myxoma
- Prosthetic valves
- Patent foramen ovale
- Cardiolyopathy

3. Miscellaneous

- Fat emboli
- Air emboli
- Tumour emboli

C: Haemorrhage (20%)

- In to the brain substance-parenchymal (15%) and/or subarachnoid space (5%)
- Hypertension
- Amyloid vasculopathy
- Aneurysm
- Arteriovenous malformation
- Neoplasm
- Coagulation disorder (haemophilia)
- Anticoagulant therapy
- Vasculitis
- Drug abuse (cocaine)
- Trauma

Diseases of blood

- Coagulopathies
- Haemoglobinopathies

Venous thrombosis

- Venous thrombosis may occur with infection and dehydration or in association with arterial occlusion when related to oestrogen excess.

Decreased cerebral perfusion

- Infarction between arterial territories may result from impaired perfusion e.g.cardiac dysrhythmia, GI blood loss.
- Pathoneruological and pathophysiological aspects.
- The pathological processes that result from a CVA can be divided into three groups.
- Thrombotic changes
- Embolic changes
- Hemorrhagic changes.

Thrombotic infarction-atherosclerotic plaques and hypertension interact to produce cerebrovascular infarcts. These plaques form at branchings and curves of the arteries. Plaques usually form in front of the first major branching of the cerebral arteries. These lesions can be present for 30 years or more and may never become symptomatic intermittent blockage may proceed to permanent damage. The process by which a thombus occludes an artery requires several hours and explains the division between stroke in-evolution and completed stroke.

Embolic infarction: the embolus that causes the stroke may come from the heart, from an internal carotid artery thrombosis, or from an atheromatous plaque of the carotid sinus. It is usually a sign of cardiac diseases. The infarction may be of pale, haemorrhagic, or mixed type. The branches of middle cerebral artery are infarct most commonly as a result of its direct continuation from the internal carotid artery. Collateral blood supply is not established with embolic infarctions because of the speed of obstruction , so there is less survival of tissue distal to the area of embolic infarct that with thrombotic infarct.

Haemorrhage: The most common intracranial haemorrhages causing stroke are those due to hypertension, ruptured saccular aneurysm, and arteriovenous (AV) malformation. Massive haemorrhage frequently results from hepertensive cardiac-renal diseases, bleeding into the brain tissue produce an oval or round mass that displaces midline structures. This mass of extravasated blood decreases in size over 6-8 months.

Saccular or berry aneurysms are thought to be the result of defects in the media and elastica that develop over years. This muscular defect plus overstretching of the internal elastic membrane from blood pressure causes the aneurysm to develop. Saccular aneurysm are found at branching of major cerebral arteries, especially the anterior portion of the circle of willis averaging 8-10 mm in diameter and variable in from, these aneurysms rupture at their dome. Saccular aneurysms are rare in childhood.

Natural course of motor recovery after stroke

Several principles of motor recovery can be summarized as follows: Approximately 90% of all stroke patients show at least some degree of motor impairment at onset, equally divided into groups of severe, moderate or mild paresis.

Without further stratification, the average of all stroke patients initial motor deficit lies at about half of the maximum best core of most motor-sensitive scales at onset, improving to three quarters of the scale's maximum at follow-up in the chronic stage 9defined as the time after which the direct and secondary consequences of ischemia have subsided and plastic processes tend to become static

The most dynamic period of recovery lies beyond the hyperacute phase (up to 48 hrs. after onset, when direct consequences of ischemia are most prominent), in the acute (up to 4 days after onset, a period in which secondary events reach full force) and subcute stages of recovery (starting anywhere as early as 48 hrs after ischemia and lasting 2-3 weeks, secondary events subside and plasticity fully unfolds), with patients reaching at least half of their individual maximum best scores within 2 weeks after parenchymal injury.

Recovery continues into the 'period of consolidation' (beginning after sub acute phase and continuing up to no more than several months after onset, a period when neurofunctional alteration wane and then followed by the chronic stage), slowing dramatically as time passes. In most cases, recovery from paresis levels off substantially 3 months after onset.

Notwithstanding the fact that motor deficits remain more or less unchanged thereafter, positive (and at times negative) functional compensation may significantly influence the degree of handicap even in the long run (Kriesel SH, 2007).

PRINCIPLES OF MOTOR LEARNING (Friedrichs CM 1996)

Amount of practice: The amount of practice and amount learned are often directly related. Several studies have shown that performance on test trials is directly related to the number of preceding presentation trials, suggesting that repeatedly guiding performance to a goal position enhances leaning.

Information feedback: It refers to information that is presented either before, during, or after an action, which informs the informer about an action's correctness or effectiveness. Knowledge of result (KR), a type of extrinsic information feedback that has been studied extensively, is defined as post-action information about the relation between an action and a predetermined environmental goal. Knowledge of performance (KP) is defined as extrinsic feedback providing information about the pattern of a movement that leads to a task goal.

Frequency of feedback: When amount of practice is controlled relative to practice with KR on every trial, withholding extrinsic feedback (reducing feedback frequency) on some practice trials enhances learning.

Scheduling of feedback: Gradually reducing the frequency of extrinsic feedback (faded schedule) across practice is more effective for skill learning than presenting feedback at a constant frequency throughout practice (constant schedule) or gradually increasing the frequency of KR across practice (reverse-faded schedule).

Timing of feedback: Knowledge of results (KR) is withheld until a predetermined set of trials are completed, then feedback about each trial in the set is presented simultaneously.

The guidance hypothesis: One hypothesis that provides a mechanism to account for these effects of KR frequency, scheduling, and timing is the guidance hypothesis. These hypotheses states that extrinsic feedback (KR) has both positive and negative effects on learning.

Guidance versus discovery learning: Guidance refers to several methods of guiding performance toward a task goal, and the amount and type of guidance used during practice appear to influence the learning process. Usually guidance is considered to be the opposite of "discovery" learning, during which performers are given a problem and encouraged to discover their own solutions.

Part-task and whole-task practice: When segments of a task are linked to provide a co-ordinated continuous movement such as walking and swimming it is referred to as a continuous task. When practicing these continuous tasks in which the co-ordination, or timing that links segments is an integral part of the task to be learned. Whole-task practice is more effective for learning than part-task learning.
Accuracy versus speed: If both the speed and accuracy are important aspects of a task, both should be emphasized early in practice. Although constant and variable practice usually results in equivalent performance on retention sessions, variable practice usually results in more effective performance during transfer sessions when performers are practicing novel speeds.

Blocked versus random practice schedule, completing practice on one task before beginning practice on a second task is often termed as blocked practice. Whereas practicing different tasks on consecutive trials is termed random practice. Several studies suggest that relative to practicing the same task over and over, intermingling different tasks throughout practice is beneficial for learning

Motor learning and recovery

Motor learning is defined as a set of processes associated with practice that lead to relatively permanent change is performance capability (Schmidt RA, 1991). Studies in healthy humans have demonstrated that incremental acquisition of motor skills follows two distinct stages : first, a nearly, fast learning stage in which considerable improvement in performance can be seen within a single training session, and secondly, a later, slow stage in which further gains can be observed across several sessions (and even weeks) of practice. It is proposed in an animal model that motor skill acquisition, or motor learning, is a prerequisite for task-related changes in the activation maps of primary motor cortex (Plautz EJ, Milliken GW and Nudo RJ, 2000), and consequently it is suggested that motor learning is required for both substitution, i.e. when undamaged brain regions are recruited to generate commands to the same muscles as were used before the injury (true recovery), and compensations, i.e. the use of alternative muscles to accomplish the task goal (Krakauer JW, 2006). Several brain structures, including the striatum, cerebellum, and motor cortical regions of the prefrontal lobe, are considered to be critical for acquisition of motor skilled behaviour, and its is suggested that the acquisition of motor skills reproduces changes in the coritico-cerebellar systems over the course of motor skill learning in healthy subject. Previous longitudinal brain imaging studies after stroke have mainly focused on the neural correlates to motor recovery, but not on whether these changes share features with brain.

MOTOR RECOVERY AFTER STROKE

Animal studies have shown that the cerebral cortex undergoes significant functional plasticity for weeks to months following injury (Nudo RJ & Milliken GW, 1996). Spared regions adjacent to the infarction and far removed from the infarction undergo functional alteration that is modified by behavioural experience (Nudo RJ, 2007). It has also been shown in an animal model that rehabilitation initiated five days after focal ischaemia was much more effective than waiting for one month before beginning rehabilitation (Biemaskie J, Chemenko G and Corbett D, 2004). This study demonstrates significant interaction between rehabilitation and spontaneous recovery processes early after stroke. The mechanism of this recovery process may be listed in three general changes within the sensorimotor network: restitution, substitution, and compensation (Dobkin B & Carmichael TS, 2005). Restitution is relatively independent of external variable such as physical and cognitive stimulation.

Restitution includes reduction of edema, absorption of blood, restoration of ionic currents, and restoration of axonal transport (Dobkin B & Carmichael TS 2005), and also reperfusion due to vessel recanalisation (Butefisch CM, Kleiser R and Seitx RJ, 2006). Substitution depends on external stimuli such as practice with the affected hemiparetic arm or leg during rehabilitation. Substitution includes the functional adaptations of diminished, but partially restored, neural networks that compensate for components lost or disrupted by the injury. Substitution may add a cost to the mental or physical energy to carry out a relearned motor skill (Dobkin B & Barmichael TS, 2005). This may contribute to explaining some of the fatigue experienced by a significant proportion of the stroke population (De Groot MH, Phillips SJ and Eskes GA, 2003), Compensation aims to improve the mismatch between a patient's impaired skills and the demands of the patient or the environment (Dobkin B & Carmichael TS, 2005).

PLASTICITY AND LEARNING

Plasticity in a general term means describing the ability to show modification plasticity or neural modifiability may be seen as a continuum from short term changes in the efficacy or strength of synaptic connections to long term structural changes in the organization and numbers of connections among neurons. Learning alters the capability for acting by changing both the effectiveness and anatomic connections of neural pathways (Shumway-Cook A and Woollacott MH, 2001).

In associative learning a person learns to predict relationships, either relationships of one stimulus to other (i.e. classical conditioning) or the relationships of one's behavior to a consequence (i.e. operant conditioning) motor skill learning can be described as a task specific modification of the spatial and temporal organization of muscle synergies resulting in smooth and accurate movement sequence (Hammond GR and Valence AM, 2006). Learning is a process of acquiring the capability for producing skilled actions. It occurs as a result of practice or experience and is assumed to produce relatively permanent changes in the capability for skilled behavior.

CELLULAR BASIS OF ASSOCIATIVE LEARNING

Associative modifications of synaptic efficiency, which are believed to underlie associative ;earmomg, depends on temporal correlation between activities in two neurons (Baxter DA and Byrne JH, 1992) possibly the best known mechanism for associative learning as proposed by Hebb in 1949. His postulate for learning states: "when an axon of cell A is near enough to excite a cell B and repeatedly or persistently takes part in firing it, some growth process or metabolic changes takes place in one or both cells such that A's efficiency as one of the cells firing B is increased".

The key feature of what is known as the "Hebbian learning rule" is that increase in synaptic efficiency depend on concurrent activity in the presynaptic and postsynaptic cells – that is, a close temporal correlation between activities in two cells. The three most prominent forms of associative synaptic plasticity are activity dependent neuromodulation, long term potentiation and long term depression.

Bilateral is isokinematic training is based on long term potentiation form of associative synaptic plasticity. Long term potentiation is a sustained increase in synaptic strength elicited by brief, high frequency stimulation of excitatory afferents. To investigate the associative properties of long term potentiation an experimental protocol was developed by Barrionuevo G and Brown MF in 1983: three stimulating electrodes were used to activate three separate presynaptic pathways to the single postsynaptic cell. The intensity of the stimulation was very weak for the two pathways, these weak stimuli elicited small sub threshold in the post synaptic cell. The intensity of stimulation was for the third pathway strong and this strong stimulation was sufficient to elicit action potential in the post synaptic cell. During the pre training period, the weakly stimulated pathways were activated alternately at a low frequency to establish a stable baseline. During training, a brief burst of stimuli in one of the weakly stimulated pathways was paired with a high frequency burst in the strongly stimulated pathway. Long term potentiation was induced only in the pathway that was paired with a strong afferent input during training. The contributing factor of strong stimulus pathway was its ability in induce a large depolarization and spiking activity in the postsynaptic cell.

HABIT-HAND ARM BIMANUAL INTENSIVE THERAPY (HABIT) (Gordon AM, Schneider JA, Chinnan A, Charles JR, 2007)

It uses the principles of motor learning (practice specificity, types of practice, feedback) and principles of neuroplasticity (practice induced brain changes arising from repetitions, increasing movement complexities, motivation and reward. Specific activities are selected by considering the rate of involved limb in the activity (e.g. stabilizer, manipulator, active / passive assist.). Task demands are graded to allow for success.

Difficulties are progressed with specific rules associated with success. Task performance is recorded. Both positive reinforcement and knowledge of performance is used to motivate performance and to reinforce target movement.
Subjects are engaged in two types of structured practice during the intervention, whole task and pat task practice. During the performance of whole task practice, activities were performed continuously for at least 15-20 minutes but no longer than 1 hour. Targeted movements and spatial and temporal movement co-ordination are practiced within the context of completing a task. (e.g. playing a board game)

Part task practice involved practicing a targeted movement exclusive of other movement. It is analogous to shaping in psychology and CIMT literature. Specifically symmetrical bimanual movements are often used to elicit a targeted movement (e.g. putting game pieces away simultaneously with each hand). Because of the simplicity of control, the frequency of successful task completion is recorded and task is repeated for 5 times.

Task difficulty is graded as the subjects performance improved by requiring greater speed or accuracy or by providing task that requires more skilled use of the involved hand and arm (e.g. moving from activities in which the involved limb acted as astabilizer to activities that required manipulative skills). The major deficits of the left hemiparetic patients involved heavy reliance on feedback control with the affected hand, and poor bimanual co-ordination at movement onset, which might be specifically retrained during stroke rehabilitation. Preservation of inter-limb co-ordination at movement end in stroke patients suggested that they retained flexibility in response to the impaired temporal performance of the affected hand to achieve the end goal (Wu CY et al, 2009).

SPECIFICS OF HABIT

Start with an easy task to build confidence. Agree upon how each hand will be used (e.g. reaching on more affected side). View each movement as an opportunity for practice. Think about how you hand objects, placement=, positioning, etc. Minimize verbal prompting (i.e. use your let, hand ….). Always give positive reinforcement, KR. Use whole and part practice. Mix fine and gross activities. Progress skills using spatial and temporal constraints. Use kinematic mirroring, examples. Group vs. Individual activities. Establish clear criteria for progressing. Homologous vs. non-homologous movements? Planning problems – how to sequence two hands. Keep fun!!

NEURAL BASIS OF BIMANUAL ACTIVITIES WHICH IS BASED ON BILATERAL ISOKINEMATIC TRAINING APPROACH

To appreciate the possible interaction between the two hemispheres and potential mechanism for one sensorimotor system to influence the other, it is necessary to consider the process of inter hemispheric inhibition during unimanual action and removal of that inhibition during bimanual action. In the unimpaired brain during unilateral action, the ipsilateral hemisphere is inhibited, as unilateral actions are executed solely by the contralateral corticospinal tracts (Nolte Jet al 1993). Patients with lesions of the corpus callosum may show deficits in the acquisition of novel bimanual tasks but not necessarily in the execution of previously learned bimanual activities (Andres FG, 1995). Neural activity in M 1 as well as SMA can reflect specialized cortical procession associated with bimanual movements (Donchin O et al, 2002). It is well established that both the hemispheres are active when the two upper limbs are performing identical actions (Fredericks CM and Saladin LK, 1996). During bilateral iso-kinematic actions it appears that the same movement organization occurs in both hemispheres.

According to Kelso et al, when two hands perform same task simultaneously, a tight phasic relationship can be observed in which one limb tends to 'entrain' to other, causing them to function as an unit.

It appears that during bilateral isokinematic action when the pattern of one limb is disturbed the other limb tends to 'recouple' to others disturbed action. If a common organization of movement occurs in both the hemispheres during attempts at bilateral isokinematic action, then the motor system in undamaged hemisphere might provide a 'template' of appropriate firing for a restored neural network. This template is available during bilateral isokinematic training, as a transcortical communication is no longer subject to inhibition from the undamaged hemisphere during bilateral simultaneous inhibition performance. The idea that the undamaged hemisphere provides an appropriate 'template' for reorganization of the reconstructed network in the damaged hemisphere needs to take into account the finding which suggest that every skilled task has a specific spatiotemporal organization of excitation of its neural pool (Torton et al. this suggests in turn that the organization of neural networks need to be reestablished specifically for a given task. A consequent prediction is that specific task must be practiced bilaterally, at least until a point is reached at which sufficient firing patterns are re-established to allow skilled performance based on combinations or re-established patterns.

The phenomenon of long term potentiation provides plausible mechanism whereby new neural structures and their patterns of firing will be permanently re-established. Once neural networks and their patterns of the firing are re-established in the damaged cortex they will be available on an ongoing basis to the hemiphelgic arm via the crossed corticospinal pathways Long term potentiation involves simultaneous activation of a number of never fibers. In the classical Hebbian model, when an axon of one cell is repeatedly or perisistently involved in the firing of another cell, some growth process of metabolic change takes place in one or both the cells, so that the efficacy of the axon firing on other cell is increased. When separate weak and strong excitatory input arrives at the same region of the dendrite of the pyramidal cell, the weak input will become potentiated if it is activated in association with the strong on (Kandel ER, Schwartx JH and Jessel TM, 1991).

Morris JH et al (2010) in their study they compared effects of bilateral task training task training on upper limb outcomes in early post stroke rehabilitation. Supervised bilateral or unilateral training for 20mins test used. on used were action research arm test and 9-hole peg test. They concluded that bilateral training was no more effective than unilateral training and in terms of overall improvement in dexterity; the bilateral training group improved significantly less.

Beekhuizen KS and Field-Fotte EC (2008) compared functional changes and cortical neuroplasticity associated with hand and upper extremity use after massed practice (repetitive task – oriented practice) training, somato-sensory stimulation, massed practice training combined with somatosensory stimulation or no intervention, in persons with chronic incomplete trtraplegia. Massed practice training consisted of repetitive practice of functional task requiring skilled hand and upper extremity use. They found significant improvement in the group received massed practice alone.

Laura Bonzano et al (2008) studied callosal contribution to simultaneous bimanual finger movement. In their study multiple sclerosis patients and normal subjects were asked to perform sequences of bimanual finger opposition movements at different metronomes rates, then they explored the structural integrity of corpus callosum by means of diffusion tensor imaging. Significant difference in motor performance, mainly referred to timing accuracy, was observed between multiple sclerosis patients and control subjects.

Andrew M Gordon AM, Schneider JA, Chinnan A, Charles JR (2007) determined efficacy of HABIT in children with hemiplegic cerebral palsy. It was controlled randomized trial. Children were engaged in play and functional activities that provided structured bimanual practice 6 hrs per day for 10 days. The results suggest that HABIT appears to be efficacious in improving bimanual hand use. Although not even a single study have been done regarding efficacy of

HABIT in stroke patients, a lot of work has been done regarding the effect of giving bimanual practice to stroke patients.

Hoffman LR and Field-Fote EC (2007) studied cortical reorganization following bimanual training and somato-sensory stimulation in cervical spinal cord injury patient. It was a case report. After the intervention patient demonstrated improvement in sensory function, strength (the force-generating capacity of muscle), and performance of functional hand skills. Following the training, the cortical map of the biceps brachii muscle shifted anteriorly and increased in area and volume.

Rose DK and Winstein CJ (2005) determined the role of anticipatory and movement control processes for the co-ordination of bimanual target aiming in individuals post stroke. Thirty adults with chronic stroke and 30 individuals without stroke history were taken. Outcomes measures used were kinematic analyses of performance and psychometric measures of reaction time, movement time, peak resultant velocity, time to and after peak resultant velocity and interlimb timing for movement initiation and target impact. They concluded that the inter-limb coordination that emerged for the stroke group revealed a anticipatory and motor control processes. We suggest that this coordination may be harnessed for future bimanual intervention approaches to rehabilitation of upper limb function after stroke.

Martin JH, Choy M, Pullman S and Meng Z (2004) determined corticospinal system development depends on motor experience. They prevrnted limb use by intramuscular injection of botulinum toxin A into selected forelimb muscle of cat to produce muscle paralysis during the period of development of CS connection specificity, which is between post natal weeks 3 and 7. CS terminations were examined using an anterograde tracer. Preventing normal forelimb use during CS axon development produced defective development of CS terminations at week 8 and in maturity. There were reductions in the topographic distribution of axon terminals, in terminal and preterminal branching, and in varicosity density. This suggests that limb use is needed to refine CS terminals into topographically specific clusters of dense terminal branches and varicosities.

Lewis GN and Byblow WD (2004) studied bimanual co-ordination dynamics in the post stroke hemiparetics. Post stroke hemiparetics individuals (n=9) and control group (n=9) completed a frequency-scaled circle drawing task unimanual and bimanual conditions. Measures of intralimb spatial and temporal task accuracy and interlimb co-ordination parameters were seen in both limbs of the patients and control with the introduction of bimanual movements. Therefore, in this particular bimanual task, performance improvement in the hemiplegic side could not be elicited.

Stinear JW and Byblow WD (2004) conducted a pilot study regarding whether repetitive bimanual co-ordinated movements enhanced upper limb corticomotor excitability and motor function post stroke. Patients practiced driving their paretic wrist through passive rhythmical flexion-extension by active flexion-extension of their unaffected wrist using purpose built manipulanda over a 4-weel period. Both pre-intervention and post intervention motricity was assessed using the upper limb fugyl-meyer rating scale, and cortical maps of wrist flexor and extensor representations were derived from potentials evoked by transcranial magnetic stimulation. Findings suggest that APBT-active-passive bimanual movement therapy can initiate an improvement in motricity that is accompanied by a balancing of between hemisphere CM (Cortico-motor) excitability.

Murase N, Duque J, Mazzocchio R, Cohen LG (2004) studied influence of interhemisphere interavtions on motor function in chronic stroke. The results document an abnormally high interhemispheric inhibitory drive from M1 intact hemisphere to M1 lesioned hemisphere in the process of generation of a voluntary movement by the paretic hand. It is conceivable that this abnormality could adversely influence motor recovery in some patients with sub-cortical stroke, an interpretation consistent with models of interhemispheric competition in motor and sensory systems.

Eastridge KM and Rice MS (2004) determined whether the motor performance in a cross transfers training was influenced by having a goal associated with the training task. Sixty right handed participants were included. The task involved cranking resistive wing nuts in and out of a test device.

Participants who trained their left limbs had a greater pre-test post test difference than participants in the control group. This study supported that occupational therapy's core belief that participating in goal oriented occupation can enhance motor performance.

Luft AR et al (2004) examined the effect of bilateral arm training with rhythmic auditory cueing on arm function. Conducted a study on twenty one chronic stroke survivors were included in the study. Results indicated that participants in the bilateral arm training with rhythmic auditory cueing group increased hemispheric activation during paretic arm movement. They concluded that bilateral arm training with rhythmic auditory cueing induces reorganization in contralesional motor networks and provide biological plausibility for repetitive bilateral training as a potential therapy for upper extremity rehabilitation in hemiparetic stroke.

Stevens JA and Stoykov MEP (2004) studied the effects of bilateral movement training through mirror reflection. The practice is intended to strengthen muscles and refine movements. It also provides examples for the recovering body and brain as they attempt to re-establish the new delicate cognitive and neural connections mediating voluntary behavior. The results were very promising as the subjects showed improved hand function as well as increased speed of the voluntary movements.

Gordon AM and Charles J (2004) proposed hand arm bimanual intensive therapy (HABIT) for improving bimanual co-ordination in children with hemiplegic cerebral palsy. HABIT retains the two major elements of pediatric constraint induced therapy (intensive structured practice and children friendliness) they proposed that extensive targeted practice can be provided in a child-friendly manner without using a physical restraint, although till that time efficacy of such an approach was not determined.

Stewart K et al (2003) determined the overall effectiveness of rehabilitating with bilateral movements. These meta –analysis findings indicate that bilateral movements alone or in combination with auxiliary sensory feedback are effective stroke rehabilation protocols during the sub acute and chronic phases of recovery.

Marshall RS et al (2002) studied evolution of cortical activation during recovery from corticospinal tract infarction. Statistically significant voxels during a finger thumb opposition task were identified with an automated image processing compare relative contributions of the 2 hemispheres to motor function in acute in the sensory motor cortex from early contralesional activity to late ipsilesional activity suggest that a dynamic bihemispheric reorganization of motor networks occurs during recovery from hemiparesis.

Nagel MJ and Rice N (2001) investigated the cross transfer effects in learning fine motor skill. Study was conducted on forty eight right handed normal participants. Participants in the training group completed a toy maze three times a day for seven days using their left hands. The results indicated that there was significant decrease in performance time and force oscillation in the untrained limb. It suggests that the cross transfer can occur in occupationally embedded tasks.

Rice MS and Newell KM (2001) Examined the interlimb coupling in the left hemiplegic population. Study was done on twenty healthy individuals and eighteen individuals with post right cerebral vascular accident with left hemiparesis. Thet suggested that during bilateral movements, the affected limb may constrain the unaffected limb. They also concluded that more research is needed to examine the coupling relationship between the affected and the unaffected limb improved active and passive ranges of motion, which were maintained after eight weeks of training cessation.

Huing Ma and Trombly CA (2001) compared the kinematics performance between part and whole task in elderly persons. 20 elderly persons without motor problems were included in their study. It was concluded that whole task condition elicited a more efficient, more forceful. And smoother movement than the part task condition.

Muide MH and Matyas TA (1996) studied effects of bilateral practice in upper extremity retraining after stroke. Eight single case, multiple baseline experiments on post-acute stroke subjects compared bilateral isokinematic training (BIT) against unilateral practice with the hemiplegic upper extremity (four experiments) or against bilateral practice with hands linked (four experiments). Unilateral performance with the hemiplegic arm of three grasp and reach actions (block placement, simulated drinking, peg to eye level target) was measured by blind, standardized observational kinematic analysis over four phases of ten daily sessions. For all three actions, phases 1 comprised baseline of either unilateral practice or bilateral practice with linked hands. Baselines continued until introduction of BIT in staggered orded to each of the three actions in phases 2, 3, or 4. Improvement were statistically superior to the generally negligible effects of unilateral or hands linked practice for all three actions in six experiments.

Finn N (1995) studied effectiveness of task oriented approach in a 34 year old woman with left hemiplegia. She concluded that the use of task oriented approach in the case provided a valuable framework for treatment planning. The study also concluded that the effectiveness of task oriented approach needs to be evaluated in terms of improved occupational performances.

STUDY DESIGN:

- Randomized control study design.
- Experimental pre and post test design.
- Subjects: both male and female patients were taken. Both right and left hemiplegics were taken.
- Total number of subjects – 30
- Study was conducted at Urc Hospital Erode

Inclusion criteria:

- Time since onset of stroke >6months.
- Age>18 years.
- Measurement of reduced upper limbs function.
- Minimum level 2 chedoke MCmaster impairmen Inventory. (Appendix A)
- Intact sensation and protective reaction.
- There should be no cognition or perceptual problem.
- No other significant medical condition.

Exclusion criteria:

- Visual problem that could interfere with performing intervention or testing.
- Increased spasticity (grade 2 Modified Ashworth scale.
- Shoulder subluxation / shoulder pain.
- Independent variable: Duration and frequency of bimanual activity.
- Dependant variable: involved upper extremity functioning.

INSTRUMENTATION

Wolf Motor Function Test (WMFT): This test was developed to assess changes in upper-extremity (UE) impairment status for patients after mild to moderate stroke. This test is based on a continuous (time) scale and progress tasks relative to the number of joints used to perform the movement. This progression is sequenced from selective activation at the shoulder joint to complex but functionally relevant movements, such as turning a key in a lock, that involve segmental coordination. Ideally, changes scores should reflect improved capability. This test consists of 15 timed tasks and 2 strength tasks. The primary outcome measure is the mean score of the 15 timed tasks. The strength tasks are scored independently from the overall score. The time of administration to score both UEs is approximately 40 minutes (Wolf SL, McJunkin JP, Swanson ML, Weiss PS, 2006). Interrater reliability for the WMFT ranges from 0.97 to 0.99. the scale and the normative data regarding the scale is given in appendix.

Action Research Arm Test: The Action Research Arm Test (ARAT) was developed by Lyle. It is performance test of upper extremity motor function which consists of 19 items divided into four hierarchical subtests. However the 15-item scale can be used for adaptive testing, i.e. using only a selected subset of items based on prior knowledge about the patient's abilities, thus minimizing testing time (Lee JHV 2002). There are four subsets: Grasp, Grip, Pinch, Gross Movement. The duration of test is 8 minutes, however in adaptive testing this duration can be further reduced. The action research arm test was constructed for assessing recovery of upper extremity function after cortical injury. The inter-rater reliability and validity of the ARAT in stroke patients, intra-class correlation co-efficient (ICC) for the total score is 0.98 indicating very high inter-rater reliability. ICCs is also very high in each of the subscales (Hsieh CH, Hsueh IP, Chiang FM, Lin PH, 1997). ARAT score of between 3 and 51 (maximum score 57) indicates a persistent motor weakness with the preserved ability to make some movement with the affected arm. ARAT can be used for measuring recovery of arm-handed function in stroke patients. The normative data is not available (Van Tuijil JH, Janssen-potten YJM and Seelen HAM, 2002). The study of stroke and its treatment in human subjects requires accurate measurement of behavioral status. Arm motor deficits are among the most common sequelae after stroke. The Action Research Arm Test (ARAT) is a reliable, valid measure of arm motor status after stroke (Yozbatrian N, 2008).

The Mini Mental State Examination (MMSE): The Mini Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall and language. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely. The MMSE is effective as a screening tool for cognitive impairment with older, community dwelling, hospitalized and institutionalized adults. Assessment of an older adult's cognitive function is best achieved when it is done routinely, systematically and thoroughly. Since its creation in 1975, the MMSE has been validated and extensively used in both clinical practice and research. The MMSE is effective as a screening instrument to separate patients with cognitive impairment from those without it. In addition, when used repeatedly the instrument is able to measure changes in cognitive status that may benefit from intervention. However, the tools is not able to diagnose the case for changes in cognitive function and should not replace a complete clinical assessment of mental status. In addition, the instrument relies heavily on verbal response and reading and writing. Therefore patients who are hearing and visually impaired, intubated, have low English literacy, or those with other communication disorders may perform poorly even when cognitively intact.

Procedure: Out of 30 subjects, 15 were in experimental group and another 15 were in control group. Subjects in experimental group were given hand arm bimanual activities and conventional Occupational Therapy only. Subjects in control group were given conventional Occupational Therapy only. The activities in control group were traditional activities like sanding, weight bearing and those which are based on different approaches already existing. Some of the activities were unimanual and some were bimanual. Each patient did bimanual activities for at least 5-6 hours daily in experimental group. Attendant kept activity log to monitor compliance at home.

Control group: 15 subjects in this group were given the following activities / instruments.

- Bilateral inclined sanding.
- Horizontal standing.
- Pronator / supinator activities.
- Pegs of different shapes and sizes.
- Weight bearing activities.

These activities were chosen because these are the traditional activities which were available. Most of these activities are helpful in improving the voluntary function, grasp improvement and normalization of muscle tone.

In the department subjects were engaged in performing activities and the activities were selected according to the capability and interest of the subjects. Subjects were encouraged to continue the activity without break for 15-20 minutes after initiation of the activity. Subjects could do an activity for a maximum of 1 hour. Subjects were provided home management programme. The subjects did the activities in home for at least 3-4 hours. In home management programme, subjects were told about different weight bearing activities.

- Prone on elbows.
- Prone on hands.
- Weight bearing in sitting position.
- Weight bearing in standing position.
- Side lying position.

According to the Bobath approach these activities are helpful in normalizing the muscle tone, in improving voluntary function and the stability at the proximal joints.

Experimental group: In addition to the above stated conventional programme, subjects were given hand arm bimanual activities. These activities are as follows.

- Threading a needle.
- Wrapping up gifts.
- Fastening zipper of a jacket.
- Buttoning and unbuttoning.
- Sharpening a pencil.
- Taking cap of a bottle.
- Opening mail.
- Squeezing tooth paste on tooth brush.
- Peeling onion and potatoes.
- Nuts and bolts.
- Scissors.
- Calculator.

These activities were chosen because they matched the criteria of activities which are given in HABIT and also have been used in earlier studies to find out the effects of bimanual activities on hand function (Penta M, Thonnard JL, Tesio L, 1998).

The duration, frequency and schedule of the activities was similar as that for the controlled group.

PRONE ON ELBOWS

TAKING CAP OFF A BOTTLE

Data analysis was done with SPSS version 16.0 package to compare pre and post therapy effects. Mean and standard deviation were used to determine the subject characteristics of both experimental group and control group in terms of age. To test the hypothesis, nonparametric test were used as the conditions of parametric test could not be fulfilled. Mann-Whitney U test was used for analysis between the group and wilcoxon signed rank test was used for the analysis within the groups. Level of significance was set at .05. convenient sampling was done.

DEMOGRAPHIC DATA:

- Number of subject: 30
- Minimum age: 18 years
- Maximum age: 75 years
- Mean of age: 54.70 ± 11.899 years
- Number of right sided hemiplegics: 24
- Number of left sided hemiplegics: 6
- Number of females: 8
- Number of males: 22

15 patients were allotted to experimental group and 15 to control group. Mann Whitney U Test was used to analyze the pre and post therapy scores of ARAT and WMFT between the experimental and control group. It was also used to analyze the individual subtests scores of ARAT between experimental and control group.

Table-1 (Variable of ARAT)
Mann Whitney U Test
(Between groups)

S.NO	Variables	Zscore	P values
1	GRASP	-1.74	0.08
2	GRIP	-1.44	0.14
3	PINCH	0.00	1.00
4	GROSS MOVT.	-5.23	0.00

Table-2(Total score of ARAT and WMFT)
Mann Whitney U Test
Between group

S.no	Variables	Z score	P values
1	ARAT	-3.31	0.001
2	WMFT	-2.65	0.008

From the table-1 the results for ARAT, WMFT and gross movement component of ARAT was found to be significant as the p values were 0.001, 0.008 and 0.00 respectively. However, the grasp, grip and pinch component of ARAT could not show the significant results. It means that regarding the p values of ARAT, WMFT and gross movement component of ARAT, the improvement was more in experimental group as compared to control group.

This has been further illustrated in the following graphs. The graphs are showing the pre and post therapy mean difference with standard error for experimental and control group regarding ARAT and WMFT.

GRAPH-1 ARAT TOTAL ACORE MEAN AND STANDARD ERROR

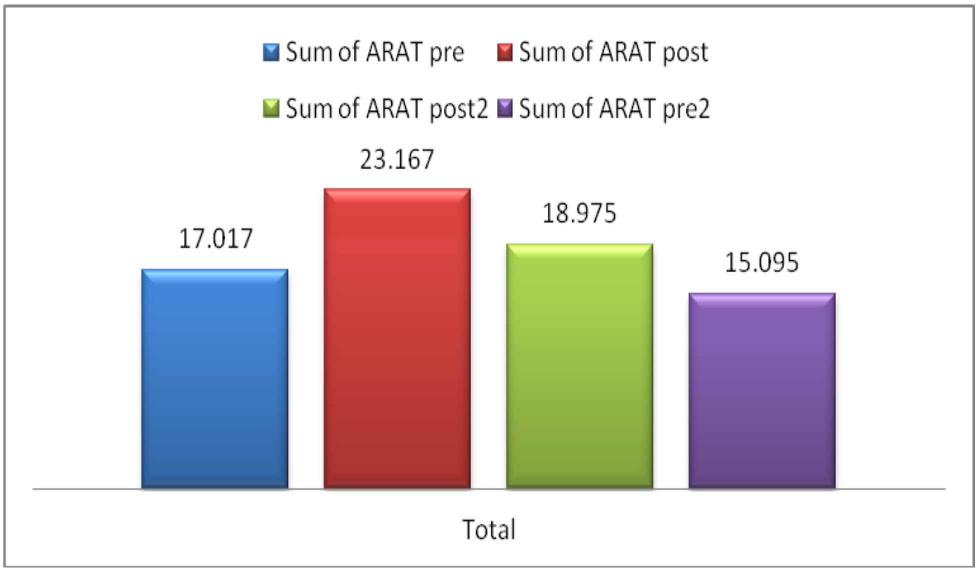

TABLE-3: ARAT MEAN AND STANDARD ERROR OF TOTAL SCORE

	Experimental		Control	
	ARAT pre	**ARAT post**	**ARAT pre**	**ARAT post**
Mean	16.20	22.40	14.60	18.40
Std.Error	0.817	0.767	0.495	0.575

From this graph and table it is clear that ARAT total score (pre test) waslesser than the ARAT total score (post test) in both experimental group as compared to control group. However, the improvement was more in experimental group as compared to control group.

GRAPH-2 WMFT SCORE MEAN AND STANDARD ERROR

Wolf motor function

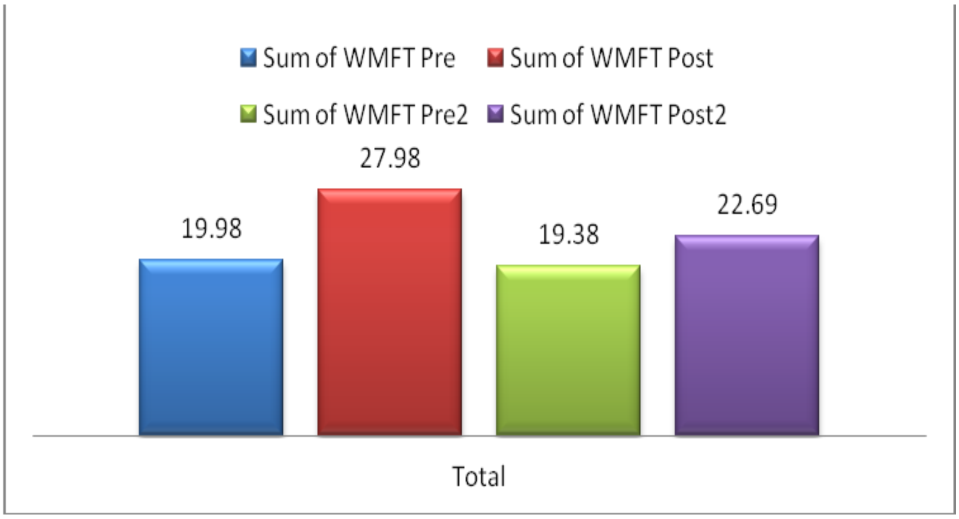

TABLE-4 WMFT SCORE MEAN AND STANDARD ERROR

	Experimental		Control	
	WMFT Pre	**WMFT Post**	**WMFT Pre**	**WMFT Post**
Mean	18.06	26.46	18.53	22.20
Std.Error	1.92	1.52	0.85	0.49

From this graph and table it is clear that WMFT score (post) was more than the WMFT score (pre test) in both experimental group as compared to control group. Pre and Post test score of subtests of ARAT (grasp, grip, pinch and gross movement) in experimental and control group were analyzed by Wilcoxon signed Rank Test.

TABLE-5

WILCOXON SIGNED RANK TEST

(Within group)

Sr.No	Variables	Experimental		Contol	
		Z Score	P value	Z Score	P Value
1	GRASP	-3.12	0.002	-2.33	0.02
2	GRIP	-1.00	0.31	-2.00	0.40
3	PINCH	0.00	1.00	0.00	1.00
4	GROSS MOVT	-3.55	0.00	-3.00	0.003

This table illustrates that both experimental and control groups showed the statistically significant improvement in grasp and gross movement component of ARAT when pre and post test score were analyzed within the groups.

This has been further ilustrated in the following graphs. The graphs are showing the mean difference of ARAT (ie, grasp, grip and gross movement) in both experimental and control group.

GRAPH-3 GRASP COMPONENT (ARAT) MEAN AND std ERROR

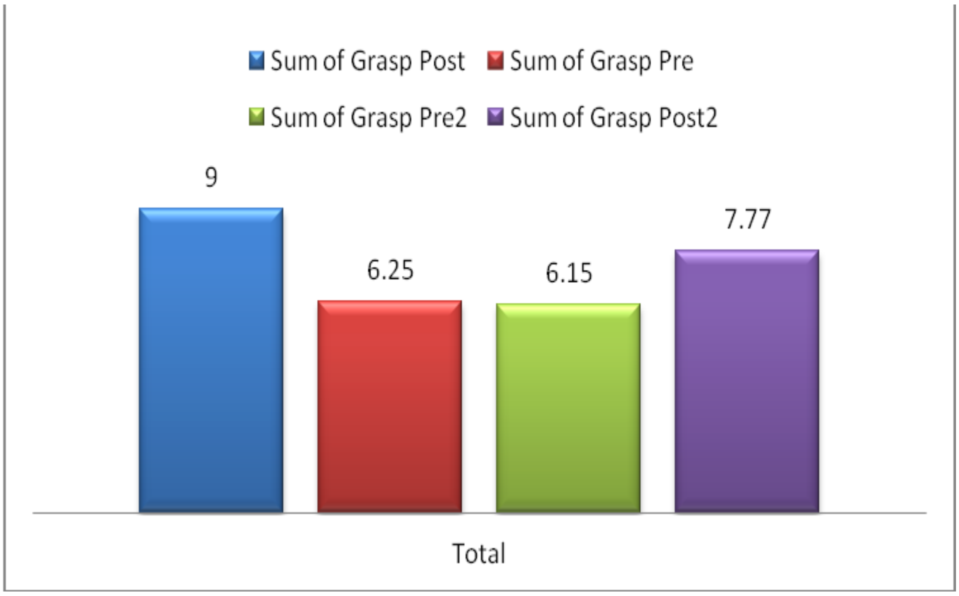

TABLE-6 GRASP COMPONENT (ARAT) MEAN AND STD ERROR

	Experimental		Control	
	Grasp Pre	**Grasp Post**	**Grasp Pre**	**Grasp Post**
Mean	5.80	8.40	5.80	7.20
Std. Error	0.45	0.60	0.35	0.57

This graph and table is showing that post test score of grasp component of ARAT was more than pre test score in both experimental and control group. However, the improvement was more in expermental group. From table-5 it can be conclided that the results were significant.

GRAPH-4 GRIP COMPONENT (ARAT) MEAN AND std ERROR

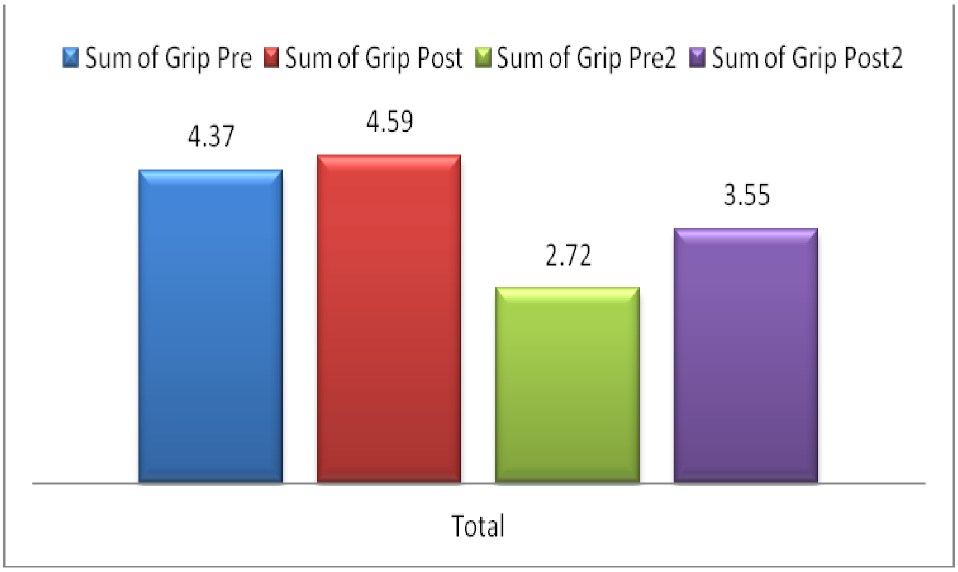

TABLE-7 GRIP COMPONENT (ARAT) MEAN AND STD ERROR

	Experimental		**Control**	
	Grip Pre	**Grip Post**	**Grip Pre**	**Grip Post**
Mean	4.00	4.20	2.40	3.20
Std.Error	0.37	0.39	0.32	0.35

This graph and table is showing that post test score of grip component of ARAT was more than pre test score in both experimental and control group. However, the results were not statistically significant (table-7).

GRAPH-5 PINCH COMPONENT (ARAT) MEAN AND std ERROR

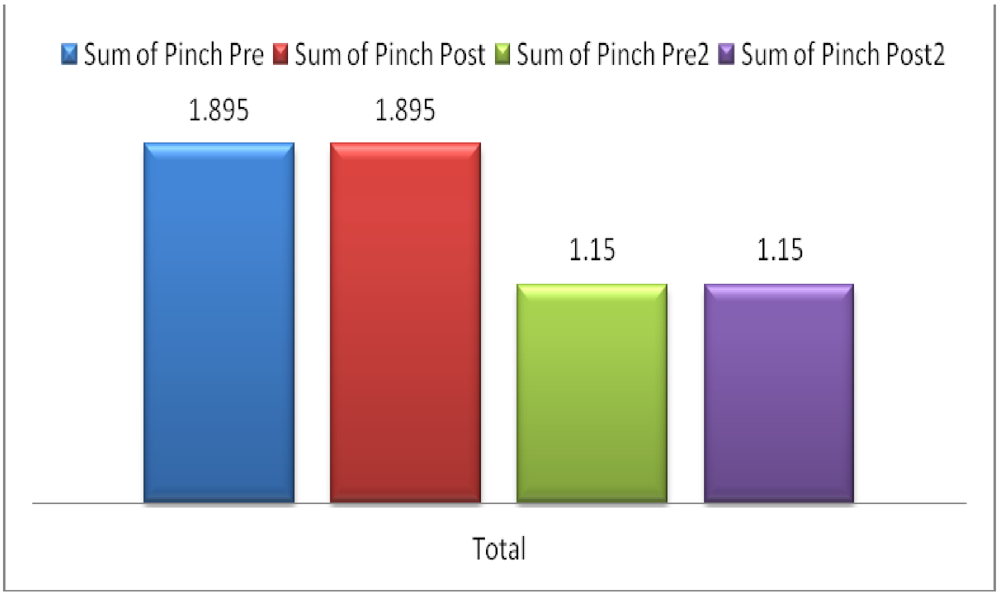

TABLE-8 PINCH COMPONENT (ARAT) MEAN AND STD ERROR

	Experimental		Control	
	Pinch Pre	**Pinch Post**	**Pinch Pre**	**Pinch Post**
Mean	1.40	1.40	0.80	0.80
Std.Error	0.50	0.50	0.35	0.35

This graph and table is showing that post test score of Pinch component of ARAT was more than pre test score in both experimental and control group. Table-8 is also shwing the same results.

GRAPH-6 GROSS MOVEMENT (ARAT) MEAN AND std ERROR

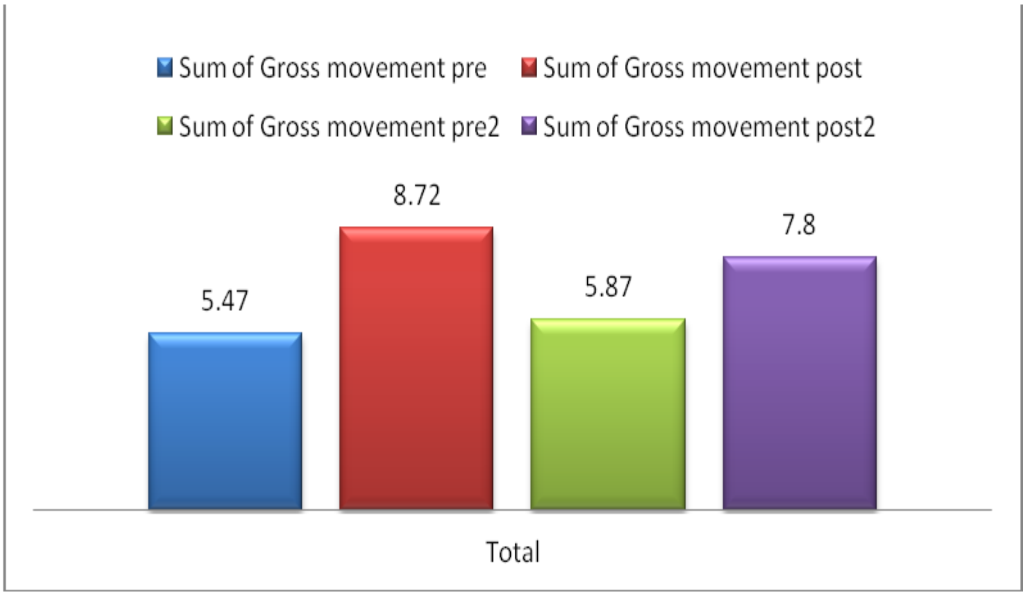

TABLE-9 GROSS MOVEMENT (ARAT) MEAN AND Std. ERROR

	Experimental		Control	
	Gross movement pre	Gross movement post	Gross movement pre	Gross movement post
Mean	5.00	8.40	5.60	7.40
Std.Error	0.47	0.32	0.27	0.40

This graph and table is showing that post test score of gross movement component of ARAT was more than pre test score in both experimental and control group. The improvement was more in experimental was more inexperimental group than the control group. The results were also significant(table-9)

HABIT (Hand-Arm Bimanual Intensive Therapy) was used initially for the CP children and it proved to be useful (Gordon AM, Schneider JA, Chinnan A, Charles JR, 2007). However literature search including the CINHAL and PUBMED search did not reveal any study indicating the effectiveness of HABIT on upper extremity function in adult stroke patients. Therefore, aim of this study was to find out the effectiveness of HABIT in adult stroke patients.

Findings of this study are consistent with other studies providing intensive practice, although the duration of HABIT given to the patients in this study was shorter because of non-compilance, but from this study it can be said that HABIT is useful for adult stroke patients in improving the upper extremity function. Although HABIT was invented to deal with bimanual coordination (Gordon AM and Charles J, 2006), it has also proved to be effective in improving the upper extremity function.

Analysis of pre test and post test total scores of ARAT (Action Research Arm Test) and WMFT (Wolf Motor Function Test) showed significant improvement in upper extremity function. However, the improvement was higher in experimental group than in the control group. The exact reason for more improvement in experimental group could not to be attributed to any factor, but the findings are consistent with other studies in which bimanual activities were given to the patients. (Mudie MH and Matyas TA, 1996; Gerloff C and Andres FG, 2002; Walter et al, 2002; Stewart K et al, 2003; Lewis GN and Byblow WD, 2004; Stinear JW and Byblow WD, 2004; Luft AR et al, 2004; Stevens JA and Stoykov MEP, 2004).

On analysis, the improvement was found in grasp and gross movements in both the groups. However, improvement was more in the experimental group. Results of grip and pinch did not show any significant improvement. It can be due to the functional status of the subjects as the subjects were not able to grip and pinch the objects efficiently. Because the patients could not get the experience of doing these activities, the improvement probably could not be seen in these areas. Results could not be matched with normative data as the same is not available (Van Tuiji JH, Jansen-Potten YJM and Seelan HAM, 2002, Appendix 'B').

Whereas normative data for WMFT (Wolf Motor Function Test) is available and given in the Appendix 'C' (Wolf SL, Mc Junkin JP, Swanson ML, Weiss PS, 2003) but that is according to the components of the scale and in this study the total score of WMFT has been analyzed and not the components.

Improvement was not mainly due to the HABIT (Hand-Arm Bimanual Intensive Therapy) only: some spontaneous recovery also might have played a role. The HABIT might have facilitated the recovery of hand function also which can explain the more and faster improvement in experimental group than the control group.

This study suggested specificity of training in terms of type of activity, duration and frequency of activity, which are to be kept in mind while giving HABIT, Gordon AM Schneider JA, Chinnan A, Charles JR, 2007 suggested to grade the activities for better results. In this study activities were graded in which involved hand could be used either as a stabilizer or manipulator, from passive assist to active and from asymmetric movement to symmetric movement. These activities were graded by means of changing spatial and temporal constraints. For example symmetrical task were graded by increasing the frequency of task.

HABIT is based on motor learning and neuro-plasticity principles. It is now generally accepted that cortical maps are dynamics and can be remodeled by behaviorally relevant experience (Martin JH, Choy M, Pullman S, Meng Z, 2004).many studies have demonstrated cortical reorganization following peripheral or central alteration of inputs and in response to behavioral manipulation (Hoffman LR and Field-Fotte EC, Kleim JA et al, 2004). At the representational level, plasticity of sensory maps is expressed as changes in cortical receptive fields and has been described in several modalities (Boroojerdi Bet al, 2001). HABIT (Hand-

Arm Bimanual Intensive Therapy) gives the alteration of inputs by means of changing the temporal and spatial components of activity.

The bimanual activities were given for 5-6 hours per day according to the schedule of HABIT. Principles of motor learning state that amount of practice is directly related to motor learning. The intense practice has proved to be beneficial in CP children and stroke patients (Gordon AM, Schneider JA, Chinnan A Charles JR,2007).

Feedback also plays a major role in learning. It can be affect if the sensory problems were not included in this study. As the environment also affects the motor learning, it was made comfortable, non-distracting, and soothing for the patient (Friedericks CM, 1996).

Activities were given as part task or whole task depending upon the functional upper extremity in the individual subject in this study. Both the practices are permissible in HABIT, but it has been proved that whole task condition elicits a more efficient, more forceful, and smoother movement than the part task condition (Trombly CA and Ma hl, 2001).

HABIT was designed for use in children with unilateral upper extremity impairments to target specific deficits, including impairments in spatial and temporal control, and findings of developmental disuse, specifically during bimanual activities. In the same way CIMT was also designed initially for the CP children. It was further tested on the stroke patients and the results proved that CIMT can be useful for the adult stroke patients and the result proved that CIMT can be useful for the adult stroke patients also (Lee JHV, 1999). The key component of both CIMT and HABIT is intense practice. The intense practice has proved to be beneficial in CP children and stroke patients to find out whether it can be useful for the adult stroke patients.

In this study subjects were given bilateral graded functional activities ranging from simple stabilizing activities to complex manipulating functional activities. Bimanual interventions in the adults with stoke have been conducted although these studies have largely used repetitive or cyclical (e.g. repetitive cycling with the two hands) tasks (Stinear JW and Byblow WD, 2004 and Morris JH et al, 2008). But HABIT targets the functional activities in which patients don't perform the simple repetitive or cyclical movement but functionally useful movement. Thus HABIT is consistent with the recent emphasis on functional training and practicing predefined goals in therapeutics environments. (Gordon AM, Schneider JA, Chinnan A Charles JR, 2007).

In this study the activities were selected in such a manner that, involved hand could also be used by the subjects. Adults with hemiplegia are strikingly adept at using only their non-involved extremity to perform tasks for which we require both hands, even if it is at the cost of efficiency (e.g. performing tasks sequentially or using body parts as a brace). HABIT tasks must be bimanual to train specific co-ordination skills. There is a spatial and temporal in-coordination associated with using two hands together in stroke patients. Often their natural tendency would be to over-compensate with their non-involved extremity(reach into the involved extremity's hemispace), Thus far more attention must be provided to the choice of activities and structuring the environment besides reminding the person to use the involved extremity (Gordon AM, Schneider JA, Chinnan A, Charles JR, 2007). The recovery of coordinated motor function after stroke onset has been associated with the practice of upper limb movements that require the activation of homologous muscles. This finding suggests that active-passive bimanual movement therapy can initiate an improvement in motricity that is accompanied by a balancing of between- hemisphere cortico-motor excitabitity (Stinear JW and Byblow WD, 2004).

It has been proposed that inter-hemispheric inhibition between lesioned and intact hemisphere is more in chronic stroke patients as compared to normal individuals. This abnormality could adversely influence motor recovery in some patients with subcortical stroke, an interpretation consistent with models of inter-hemispherics competition in motor and sensory system (Murase N, Duque J, Mazzocchio R and Cohen LG, 2004). It may have the effect on motor recovery in stroke patients, as in relearning a movement or skill it will be more difficult for stroke patients as comparded to normal healthy individual. However, there are many studies which have proved that bimanual activities bring physiology changes in the brain which are in favor of recovery. (Renner CIE, Woldage H, Atanasova R and Hummelsheim H,2005; Luft AR, 2004).

Bilateral movement enhances activation in the primary motor cortex (M1)of the affected hemisphere as comparded to the unilateral paretic hnd movement. With recovery, activation of M1 in the affected hemisphere does not differ between unilateral paretics hand and bilateral movement (Staines WR, Mcllroy WE, Graham SJ and Black SE, 2001). Therefore bimanual movements are beneficial in recovery. It may be said that bimanual movements enchance the recovery rate but not the extent of recovery.

In this study, all the stroke patients had duration of more than six months and were assessed to have minimum level 2 on Chedoke Mc Master impairrment inventory. These subjects were having the cognitive and perceptual problems were excluded from the study.

The improvement in bilateral activities can be explained with the concept of inter-cerebellar coupling which is the key for the execution of simultaneous bimanual movements.(Pollock B et al, 2007). Gerloff C and Andres FG (2002) have also explained this concept of bimanual coupling.

In a study where subjects were asked to perform the activities bimanually, it was seen that they took more time as compared to when they were doing the activities unimanualy with sound hand. It may be due to limited movement time of the non-paretic extremity. The decrease in speed of these performance-determining variables in the bilateral task warrants consideration during intervention for patients with hemiparesis (Dicksstein R, Hochemn S, Amdor G, Pillar T, 1993). However, in this study subjects have shown slowness in performing bilateral activities initially but later was observed that as the patients re-learned the movement the speed and smoothness improved.

There are many studies which have proved that there is no significant difference in giving bimanual or unimanual activities to the patients. In a randomized controlled trial in which bilateral upper limb tasks were compared, it was found that bilateral training was no more effective than unilateral training, and in terms of overall improvement in dexterity, the bilateral training group improved significantly less. It was suggested that intervention timing, task characteristics, dose, and intensity of training may influence the results (Morris JH et al, 2008). However, it was also found that there was no increased effectiveness of unilateral and bilateral training compared to usual therapy. In addition, another study found that during bimanual activation the impaired limb appeared to constrain the movements of the non-affected limbs, leaving the performance of the affected limb unchanged. Furthermore, investigations of the impact of bilateral training in neural mechanisms provide equi-vocal results (Coupar F et al, 2008).

There is no uniform opinion regarding the use of HABIT in hemiplegic patients as well as the effectiveness of uni/bimanual activities. However, in this study it was found that there was definitely a significant improvement in upper extremity function in hemiplegic patients when the HABIT was given to the patients

LIMITATIONS

- Sample size was smaller.
- The activities could not be given in group as suggested by the HABIT protocol.
- Instead of completing the intervention in 10 days, the same was completed in nearly one month.
- Other treatments were also given to the patients in experimental group so exclusive effect of HABIT could not be found.

RECOMMENDATIONS

- Large sample size can be used to find more Effectiveness effect with HABIT protocol.
- Long- term follow-up study can be conducted to understand the sustained effects of Habit.

CONCLUSION

In this study, significant improvement was found in the upper extremity function of hemiplegic patients. Therefore, it can be concluded that HABIT is useful for the adult stroke patients.

The patients and their attendants reported that the patients are using both hands more efficiently and the bimanual co-ordination had improved. However, the same could be assessed objectively.

The improvement was also seen in grasp and gross movements. However, the pinch and grip did not improve. There was overall improvement in the functioning of the upper extremity.

Thus, the experimental hypothesis stands proved.

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APPENDIX- I

Stages of motor recovery of the Chedoke-McMaster Stroke Assessment (Gowland et al, 1993)

Stages-1

Flaccid paralysis is present. Phasic stretch reflexes are absent or hypoactive. Active movement cannot be elicited reflexively with a facilitory stimulus or volitionally.

Stages-2

Spasticity is present and is felt as a passive movement. No voluntary movement is present but a facilitatory stimulus will elicit the limb synergies reflexively. These limb synergies consist of stereotypical flexor and extensor movement.

Stage-3

Spasticity is marked. The synergistic movement can be elicited voluntarily, but are obligatory.

Stage-4

Spasticity decreases. Synergy patterns can be reversed if movement takes place in the weaker synergy first, movement combining antagonistic synergies can be performed when the prime movers are the strong components of the synergies.

Stage-5

Spasticity wanes, but is evident with rapid movement and at the extremes of range. Synergy patterns can be reversed even if the movement takes place in the strongest synergy first, movement that utilize the week components of both synergies acting as prime movers can be performed.

Stage-6

Co-ordination and patterns of movement can be near normal. Spasticity as demonstrated as resistance to passive movement is no longer present, abnormal patterns of movement with faulty timing emerge when rapid or complex actions are requested.

Stage-7

Normal. A “normal” variety of rapid, age appropriate complex movements patterns are possible with normal timing, co-ordination, strength and endurance. There is no evidence of functional impairment completed to the normal side; there is a “normal” sensory-perceptual motor system.

APPENDIX- II

Patient Name :

Rater Name :

Date :

INSTRUCTIONS

There are four subtests: Grasp, grip, Pinch, Gross movement. Item in each are ordered so that:

If the subject passes the first, no more need to be administered and he scores top marks for that subject.

If the subject fails the first and fails the second, he scores zero, and again no more tests need to be.

Performed in that subtest; otherwise he needs to complete all task within subtest.

ACTIVITY SCORE

Grasp

- Block, wood, 10cm cube (if score =3, total =18 and to Grip)
  ________________ pick up a 10cm block
-
- Block, wood, 2.5cm cube (if score=0, total=0 and go to grip)
  ________________pick up 2.5cn block

- Block, wood, 5cm cube ________
- Block, wood, 7.5cm cube_____________
- Ball (cricket), 7.5cm diameter____________
- Stone 10 x 2.5 x 1 cm_____________

- ❖ Coefficient of reproducibility =0.98
- ❖ Coefficient of scalability =0.94

GRIP

- Pour water from glass to glass (if score =3, total = 12, and go to pinch) 2. Tube 2.25 cm (if score=0 and go to pinch)
- Tube 1 x 16 cm
- Washer (3.5cm diameter) over bolt_________
- Coefficient of reproducibility =0.99
- Coefficient of scalability =0.98

PINCH

- ❖ Ball bearing, 6mm, 3rd finger and thumb (if scores=3, total=18 and go to Grossmt) _____________
- ❖ Marble, 1.5cm, index finger and thumb (if scores=0, total=0 and go to Grossmt) _____________
- ❖ Ball bearing 2nd finger and thumb ______________
- ❖ Ball bearing 1st finger and thumb ______________
- ❖ Marble 3nd finger and thumb ______________
- ❖ Marble 2nd finger and thumb ______________
- ❖ Coefficient of reproducibility =0.99
- ❖ Coefficient of scalability =0.98

GROSSMT (Gross movement)

- Place hand behing head (if scores=3, total=9 and finish) _________
- (if scores=0, total=0 and finish______
- Place hand on top of head_______
- Hand to mouth___________
- Coefficient of reproducibility =0.99
- Coefficient of scalability =0.98

NORMATIVE DATE

Not available (Van Tuiji JH, janssen-potten YJM and Seelen HAM, 2002). However, action research arm test score of between 3 and 51 indicates a persistent motor weakness with preserved ability to make some movement with the affected arm (letswarrt M,2006).

APPENDIX III

WOLF MOTOR FUNCTION TEST

1. Forearm on the table (side): subjects to place forearm on the table by abduction at the shoulder.
2. Forearm to the box (side): subjects to place forearm on the box by abduction at the shoulder.
3. Extended elbow (side): subject attempts to reach across the table extending the elbow (to the side).
4. Extended elbow (to the side), with weight: subject attempts to push the sand bag against outer wrist joint across the table by extending the elbow.
5. Hand to the table (front): subject attempts to pull 1-lb weight across the table by using elbow flexion and cupped wrist.
6. Hand to the box (front): subject attempts to place hand to the box.
7. Reach the retrieve (front): subject attempts to pull 1-lb weight across the table by using elbow flexion and cupped wrist.
8. Lift can (front): subject to lift can, bring it close to lips with cylindrical grasp.
9. Lift pencil (front): subject attempts to pick up pencil by using 3-jaw chuck grasp.
10. Pick up paper clip (front): subject attempts to pick up paper clip by using pincer grasp.
11. Stack checkers (front): subject attempts to stack checkers onto the center checker.
12. Flip card (front) using the pincer grasp: patient attempts to flip each card over.
13. Turning the key in the lock (front): using the pincer grasp, while maintaining contact, patients turn the key fully to the right and left.
14. Fold the towel (font): subject grasp the towel, folds it lengthwise, and then uses the tested hand to fold the towel in half again.
15. Lift basket (standing): subject picks up the basket by grasping the handles and placing it on bedside table.

NORMATIVE DATA

Timed and strength WMFT tasks by age group.

Tasks	40-49yrs		50-59yrs	
	Right	Left	Right	Left
Forearm to table	0.6±0.1	0.5±0.1	0.5±0.1	0.5±0.1
Forearm to box	0.7±0.2	0.7±0.1	0.7±0.2	0.7±0.1
Extend elbow	0.4±0.1	0.4±0.1	0.4±0.1	0.4±0.1
Extend elbow with weight	0.4±0.1	0.4±0.1	0.4±0.1	0.4±0.1
Hand to table	0.5±0.1	0.5±0.1	0.4±0.1	0.5±0.1
Hand to box	0.5±0.1	0.5±0.1	0.5±0.1	0.5±0.1
Weight to box: male	20.0±0.0	20.0±0.0	20.0±0.0	20.0±0.0
Weight to box: female	18.9±2.5	18.5±2.5	16.0±3.1	14.9±3.5
Reach/retrieve	0.6±0.2	0.6±0.2	0.5±0.1	0.6±0.1
Lift	0.9±0.2	0.9±0.2	0.9±0.2	1.0±0.2
Lift Pencil	0.7±0.2	0.7±0.1	0.8±0.2	0.9±0.1
Lift paper clip	0.8±0.1	0.9±0.2	1.0±0.2	1.0±0.2
Stack Checkers	2.1±0.6	2.1±0.3	2.4±0.4	2.5±0.5
Flip cards	2.7±0.4	2.7±0.5	2.8±0.7	2.9±0.6
Grip strength: male	34.5±5.8	33.0±4.02	45.8±7.7	38.3±8.9
Grip strength: female	19.6±7.1	17.8±4.5	20.5±5.4	16.9±5.7
Turn key in lock	17.±0.3	17.±0.4	1.8±0.4	1.8±0.4
Fold towel	2.5±0.5	2.4±0.4	2.6±0.5	2.7±0.6
Lift basket	1.5±0.3	1.6±0.2	1.6±0.3	1.6±0.3
Mean time per timed task	1.1±0.2	1.1±0.1	1.2±0.2	1.2±0.2
Mean Male	1.0±0.1	1.1±0.1	1.1±0.1	1.2±0.2
Mean Female	1.1±0.2	1.1±0.2	1.2±0.2	1.2±0.1

Tasks	40-49yrs		50-59yrs	
	Right	Left	Right	Left
Forearm to table	0.7±0.1	0.7±0.2	0.7±0.2	0.7±0.1
Forearm to box	0.8±0.2	0.8±0.3	0.8±0.3	0.8±0.2
Extend elbow	0.5±0.1	0.5±0.2	0.5±0.1	0.4±0.1
Extend elbow with weight	0.4±0.1	0.4±0.1	0.5±0.2	0.4±0.1
Hand to table	0.5±0.1	0.5±0.2	0.5±0.1	0.5±0.1
Hand to box	0.6±0.1	0.6±0.2	0.6±0.1	0.6±0.1
Weight to box: male	20.0±0.0	20.0±0.0	19.0±2.2	19.4±0.9
Weight to box: female	17.2±3.1	16.0±3.1	13.8±4.3	11.6±1.5
Reach/retrieve	0.6±0.2	0.6±0.1	0.6±0.2	0.5±0.1
Lift can	1.1±0.4	1.1±0.3	1.2±0.2	1.1±0.2
Lift Pencil	0.9±0.3	0.9±0.2	1.0±0.1	1.0±0.2
Lift paper clip	1.0±0.2	1.0±0.2	1.2±0.3	1.1±0.2
Stack Checkers	2.7±0.6	2.7±0.6	2.9±0.6	2.9±0.6
Flip cards	3.1±0.8	3.1±0.7	3.1±0.4	3.0±0.4
Grip strength: male	40.5±9.0	39.3±5.8	28.8±7.1	34.4±4.1
Grip strength: female	24.1±7.9	19.3±7.1	18.9±6.9	18.3±5.1
Turn key in lock	2.2±0.6	2.2±0.6	2.1±0.6	2.0±0.5
Fold towel	3.0±0.6	3.0±0.8	3.2±0.7	3.0±0.4
Lift basket	1.7±0.4	1.8±0.5	1.9±0.3	1.8±0.2
Mean time per timed task	1.3±0.3	1.3±0.3	1.4±0.2	1.3±0.2
Mean Male	1.2±0.2	1.2±0.3	1.3±0.2	1.4±0.2
Mean Female	1.4±0.3	1.4±0.3	1.5±0.2	1.3±0.2

APPENDIX- IV

THE MONI-MENTAL STATE EXAMINATION

Patient :

Examiner :

Date :

ORIENTATION

5 () What is the (year) (season)(date)(month)?

6 () Where are we (state) (country) (town) (hospital) (floor)? Registration

3 () Name 3 object: 1 second to say each. Then ask the patient all 3 after you have Said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record, trails______

ATTENTION AND CALCULATION

5 () Serial 7's. 1 point for each correct answer. Stop after 5 answers, alternatively spell "world" Backward

Recall

3 () Ask for the 3 object repeated above. Give 1 point for each correct answer.

LANGUAGE

2 () name a pencil and watch.

() Repeat the following "no ifs, ands, or buts"

3 () Follow a 3-stage command: "Take a paper in your hand, fold it in half, and put it on the floor"

1() read and obey the following:

CLOSE YOUR EYES

1 () Write a sentence

1 () Copy the design shown. _____ Total score

ASSESS level of consciousness along a continuum_______________

Alert Drowsy stupor Come

MASTER CHART-1

Sl.No	Age	Sex	Side	ARAT pre	ARAT post	WMFT pre	WMFT post
1	65	M	R	21	24	25	40
2	70	F	L	15	21	16	21
3	61	F	L	15	21	16	22
4	35	M	L	12	18	16	20
5	55	M	R	18	21	20	23
6	51	M	R	15	18	22	24
7	39	F	R	15	15	22	22
8	55	F	L	12	15	24	25
9	55	M	L	15	18	15	22
10	66	M	R	15	18	19	23
11	39	F	L	12	18	20	24
12	45	F	R	15	18	18	22
13	47	F	R	12	15	16	20
14	58	M	L	15	18	15	22
15	65	F	R	15	21	15	18
16	69	M	L	12	21	8	21
17	81	M	R	15	24	12	24
18	64	F	L	18	24	24	27
19	51	M	L	18	21	24	25
20	44	M	R	15	18	24	25
21	88	M	R	15	18	24	26
22	45	F	L	21	24	25	26
23	59	M	L	15	21	23	26
24	63	F	R	18	24	8	22
25	64	M	L	12	18	9	23
26	85	M	R	15	21	9	22
27	73	M	R	21	24	24	27
28	66	F	L	18	27	22	27
29	67	F	L	15	21	24	40
30	51	M	L	12	27	10	21

MATER CHAT-2

Sl.No	Grasp Pre	Grasp post	Grip pre	Girp post	Pinch pre	Pinch post	Gross movt pre	Gross movt post
1	6	9	3	3	0	0	6	6
2	6	6	3	3	0	0	6	9
3	6	6	3	3	0	0	6	6
4	6	6	6	6	3	3	6	9
5	6	9	6	6	3	3	3	6
6	6	9	3	3	0	0	6	9
7	6	9	3	3	3	3	6	6
8	6	6	3	6	3	3	6	6
9	6	6	0	3	0	0	6	6
10	6	6	3	3	0	0	6	9
11	6	6	3	3	0	0	6	9
12	6	6	3	3	0	0	6	9
13	6	6	3	6	0	0	6	9
14	9	9	0	0	0	0	6	9
15	3	3	3	3	3	3	3	6
16	3	9	6	6	3	3	0	9
17	6	6	6	6	6	6	3	6
18	6	9	3	3	0	0	6	9
19	9	12	3	3	3	3	3	9
20	6	12	3	3	0	0	6	9
21	6	9	0	3	0	0	6	6
22	6	12	3	3	0	0	6	9
23	3	6	3	3	3	3	3	6
24	6	9	3	3	0	0	6	6
25	3	6	3	6	0	0	6	9
26	9	12	3	3	0	0	6	9
27	3	6	3	3	0	0	6	9
28	6	9	3	3	0	0	6	9
29	6	6	6	6	3	3	6	9
30	3	6	3	3	3	3	3	6

APPENDIX – VI

Date	:	
Name	:	
Age	:	
Occupations	:	
Diagnosis	:	
Durations of stroke	:	
1st episode of CVA	:	Yes/ No
Relevant medical history/ Precaution	:	
Affected side	:	
Brunnstrom stage	:	
Handedness	:	
MMSE score	:	
MAS score	:	
Sensory awareness	:	Pre/Post
Wolf motor function test	:	
Action research arm test	:	